blank day in the coldest weather, if I know there are fish in the river." A cold mist coming on will always prevent fish from rising. On a fine April day, when the sun is bringing down snow water, the time to take fish is after the sun has warmed the river, but before the snow melted by the sun about the sources of the river has had time to run down and chill the water. In both cases it is a question of the relative temperature of the air to the water.

"Do salmon feed in fresh water?" is one of the questions the author asks. He answers it in the affirmative, as he cannot believe that fish rush at spinning baits, eat prawns, and chew up a bunch of lob-worms simply to gratify the angler's love of sport. It is difficult, indeed, to understand how the theory of salmon living for months in fresh water "on his own fat, which has been accumulated while feeding in salt water"—as Dr. Francis Day puts it—could have been accepted by him, or by the late Frank Buckland. Why are good salmon rivers bad brown trout rivers? Simply because the salmon feed on the trout.

The question of close time Major Traherne says "is the key to the situation; in other words, to the adjustment of the various claims of netting proprietors and anglers, as the prosperity of our salmon fisheries, and the increase or decrease of a most valuable article of food depends in great measure upon the periods fixed to suit each river." This means that the proper adjustment of close time to each river will divide the clean fish fairly between the upper and lower proprietors, and will also provide abundant spawning fish to fill the beds upon the upper waters. At present the weekly close time in England and Scotland, extending from 6 p.m. on Saturday to 6 a.m. on Monday, is too short to enable fish to run past all the nets on many of our rivers; the upper nets sweeping in on Monday morning most of the fish that left the salt water on Saturday night. Again, the rod fishing is kept open too late. We have constantly seen gravid fish taken in October, out of which the eggs or milt ran when the fish were landed—fish that were neither able to fight, nor fit for food. Late in the season the gravid fish will take any bait as voraciously as the kelts in early spring, and the angler is able to state that he killed his six or eight heavy fish a day. After being kippered they are just eatable, and that is the best that can be said for them. On the other hand, with each of the female fish—and most of the fish killed at the end of the season are hen fish—perish some 20,000 eggs fully developed. All that Major Traherne says about the weekly close time, as well as about the closing of the fishing in the autumn, deserves careful consideration.

AN ELEMENTARY TEXT-BOOK OF GEOLOGY.

An Elementary Text-book of Geology. By W. Jerome Harrison, F.G.S. (London: Blackie and Son, 1889.)

IT is well known that there are certain things, which, like reading and writing, come by nature, such as the driving of a gig, and the management of a small farm. These every man can do. And till lately it seems to have been very generally held, that, when a man or woman had shown by repeated failure that he or she was hopelessly incompetent to earn bread in any other way, there was nothing to forbid him or her from opening a school for small children: the laying of the foundations of an education was such a simple matter that it was within the reach of everyone. It looks also as if the writing of an elementary text-book on a scientific subject is very generally held to be an equally easy task, at least the bounteous profusion with which such books are showered upon us would appear to point to such a conclusion. But anyone who has tried to teach or to write a book that shall be used for teaching purposes, knows only too well that it is with the beginner and in the elements of his subject that the real difficulty lies. And besides the inevitable obstacles to success which from the nature of things he must meet with here, there are to be taken into account others of a more artificial kind. An elementary text-book must be cheap; neither author nor publisher can be expected to be wholly indifferent to profits, and only cheap books pay in science; but, setting this consideration aside, it is of the first importance that the work should be within the reach of the largest number possible of buyers. Cheap, and therefore small and sparingly illustrated. So here arises the first difficulty. What to leave out in the text and how far illustrations may be dispensed with.

Before these questions can be answered, the author must make up his mind what end he proposes the book shall be made to compass. For there are two most distinct purposes which a text-book may be intended to serve. It may be designed to educate the reader; or it may be put together in order to help him to get through an examination. And for books of the first kind there are two classes of readers to be provided for: some will never go beyond the elements of the subject; for others the text-book is only the first step on a journey which will lead them on through all the details and ramifications of its subject. But the needs of both classes are at the outset very much the same. Both want a basis, broad and flat in its simplicity, on which they can plant their feet firmly; not a surface so rough and jagged with complicated details that they are bewildered to know where, or whether anywhere, a secure foothold is to be found on it. For both the aim of the book must be to give fibre and sinew to the mind, not to pack into it a miscellaneous assortment of useful and interesting facts; the mastery of the book must involve not the mere exercise of memory, but the continuous use of observation and the logical faculty.

In every branch of science there are certain parts which are eminently fitted to serve these ends, and other parts which will most effectually defeat them if introduced into an elementary work. Now, in the Presidential address to the British Association at the recent meeting at Newcastle the objects which ought to be exhibited in a Museum intended for popular instruction were most lucidly marked off from those that ought not: an almost identical classification will divide those parts of a scientific subject which ought to find a place in an elementary text-book from those that ought not. In the same address an emphatic warning was given against overcrowding the cases. Equally must the writer of a text-book be on his guard against congested sentences or chapters.

Here, as in all education, the course of instruction, if it is to be of any value for mental discipline, must lead up from the simple to the complex, from the particular and concrete to the general and abstract. To start with the nebular hypothesis in geology may claim to be taking things in their historical order, but is like giving meat to a baby of three months old. To lay before the beginner a familiar object such as a lump of sandstone or limestone; to show him how to pull it to pieces and find what it is made of; to give him reasons for the belief that it has not existed from the beginning of all things, but is a naturally manufactured product; to drive him to rummage brook, river, pond, and sea, the whole field of outdoor nature, in hopes of finding some similar product now in process of manufacture,—some such treatment as this at the outset would seem to be the way to lead a beginner on to use his hands, his eyes, and his reasoning faculties—in a word, to educate him. And at this stage only well ascertained facts, and conclusions on the soundness of which no doubt can be thrown, ought to be introduced; incomplete observations and experiments, inferences which are no more than likely, all provisional and speculative hypotheses, and all controversial matters, ought to be kept carefully in the background. We do not trust a youngster among quicksands and shaking bogs till much walking over sound ground has given him sturdy legs, sure feet, a quick eye, and sound judgment. There is a bit of advice given in the preface to the book now before us, which is not likely to do much harm because it certainly will not be followed by those for whom the book is written; but one shudders to think of the mental chaos that would result from reading every book or article on geology which can be bought or borrowed, the controversy on the Taconic System included. To encourage so omnivorous an appetite is not according to knowledge.

The limits of an article will not allow of more than the fringe of the subject being just touched upon; but enough has been said to show what seem to be the things to be striven after and the things to be avoided in a book on elementary science which aims to educate its readers.

The other kind of text-book is necessarily constructed on a totally different principle. The author's aim is to satisfy the requirements of a syllabus or code; lucky it is if he is a slave to only one, and does not vainly struggle to meet the demands of many. The reader must be fortified against every possible form of question which the ingenuity of the examiner can devise without going outside the prescribed limits; and as that ingenuity is boundless, the number of such questions must be legion. Hence arises the necessity of packing into a small compass an endless variety of subjects, with the result that only a few words can be spared for each. Each also, instead of standing out crisp and sharp with an appropriate heading to call attention to it and emphasize its importance, shares with two or three others, with which it may have only a remote connection, the cramped quarters of a single sentence. What a risk there must be in such a case that matters of great moment may be passed by unheeded! Even in a crowd we may stumble on interesting folk, but it is not in a crowd that intimate acquaintance or lasting friendships usually begin.

There is another evil in books of this kind; they foster the dangerous belief that there are short cuts to learning—a notion welcome enough in this age of hurry and unrest, when everything is to be done quickly, well also if you can, but quickly at any cost.

An amusing illustration of the educational value of the ordinary text-book may perhaps be allowed a place here. A girl, sharp enough to be worth taking pains with, came to me for assistance in the preparation for her examination. She was happy in the possession of a text-book which professed to give all the information which her syllabus required on I know not how many branches of science. She was just beginning the section on chemistry and was much exercised as to the meaning of chemical symbols. I was able to remove her difficulties, and to send her away hopeful that further progress would be easy and rapid. The latter it certainly was, for at the end of a week she came again with a beaming face; she had finished chemistry, and made some way in meteorology. I naturally demurred to her getting her geology in this fashion, and substituted for the geological section of her book a well-known primer. She repaid me and showed her appreciation of what scientific writing ought to be, by declaring that this was as good as a story-book.

But it would not be fair to take the precious compendium from which, but for a lucky accident, this girl would have derived all her knowledge of science, as a fair sample of the average text-book. On many even of the second class it is possible to look with qualified satisfaction, and, though the work before us must be placed in this class, it is good of its kind. There is life and spirit in it, and here and there its points are happily put. No one who reads it attentively can fail to get from it information which not only will be serviceable in examinations, but may be used as a stepping-stone to further progress in its subject. But I should like to call the attention of the author to a few points in which there seems to be room for improvement.

The exigencies of space demand that there should be no repetition in a book of this kind. But there is more than one case in which our author says over again what has been already said on a previous page. For instance, on pp. 71 and 72 we have much that has been previously given in chapter ii. The amount of dissolved matter in the Thames is stated twice over, on p. 11 and again on p. 73. Other cases might be quoted. The general arrangement of chapter viii. does not seem to be commendable: it is hard to see why such simple matters as ripple-marks, rain-pittings, and sun-cracks should come after the more complicated structures of foliation and faulting; what would seem the natural arrangement, of beginning with the simple, is absolutely reversed. The term current-bedding is used and partially explained on p. 22, but we do not find a full definition till p. 45.

A few cases of incomplete information and even of looseness of statement may be noted. In speaking of the consolidation of sediment by pressure, only the weight of the overlying rock is mentioned on p. 18. Whether glaciers move solely by the force of gravity, as is implied on p. 76, is to say the least a moot point. The description of fire-clay as "a fairly pure variety of clay, *containing but little water*," can hardly be said either to be accurate or complete. Marl is not clay mixed with *lime*. It is surprising to find among so many really good illustrations the time-honoured section across the Jura on p. 42, which only deserves to be preserved as about the most successful effort that was ever made to represent things as they are not. The two paragraphs on contorted strata and inverted strata which follow are instances of the congestion which is unavoidable in text-books of the second class. It is impossible in so small a space to give the prominence which it deserves to the conception of horizontal thrust and compression, and very few readers would realize, from the few words devoted to them, the surprising character of the thrust-planes of the Scotch Highlands. It is scarcely fair to magnetite to say that it *sometimes* exhibits magnetic properties, and ferrous carbonate does not give a green, blue, grey, or purple colour to rocks (p. 70). One and only one more objection will I urge. There is a lamentable absence of geological sections. No verbal descriptions will suffice to convey to anyone, let alone a beginner, clear notions of the geological structure of a country without illustrative sections. The reader of the present work will gather from it the parts of the country in which the various formations are seen at the surface, but he will come away with very few notions as to the lie of the rocks. I cannot help feeling that the "imaginary scenes" during the several geological epochs might be usefully replaced by a set of geological sections.

A. H. GREEN.

THE FLORA OF DERBYSHIRE.

A Contribution to the Flora of Derbyshire; being an Account of the Flowering Plants, Ferns, and Characeæ found in the County. By the Rev. W. H. Painter. 8vo, pp. 156, with a Map. (London: George Bell and Sons, 1889.)

DERBYSHIRE is much the most interesting of our midland counties from a botanical and physico-geographical point of view. Geographical botanists, following Watson, divide the surface of Britain into two regions of climate—a lower or agrarian region, in which the cultivation of cereals and the potato is practicable, so far as climate is concerned; and an upper or Arctic region, in which no cultivation is possible. The agrarian region is divided into three zones, and whilst in Surrey, Hampshire, Wiltshire, and Kent, only one of these three zones is represented, in Derbyshire, Shropshire, and Cheshire, we get all three of them, and a greater area of super-agrarian zone in Derbyshire than in any other midland county. The plants of Britain, botanical geographers divide into two principal groups—the southern types, which have their head-quarters in Central Europe, and the boreal types, which have their head-quarters in Northern Europe, and grow only upon high mountains further south. The southern types are to the northern as six to one—about 1200 species against 200; but less than 50 species reach the midland counties. In Derbyshire we get a declination of surface from mountains nearly 2000 feet high down to a low level, so that it shows better than any other county how, in the centre of England, the boreal and austral elements of the flora meet and mingle together.

The whole area of the county is a little over a thousand square miles—about one-sixth that of Yorkshire. The Pennine chain, the backbone mountain-ridge of the north of England, extends for some distance into Derbyshire forming the watershed between the streams that flow into the German Ocean and the Irish Channel. We may divide the county into two unequal halves by a line that runs across it from west to east, from Ashbourne to Duffield. South of this line, with Derby in its centre, is a level tract underlaid by new red sandstone, with a flora like that of Leicestershire, Nottinghamshire, and Warwickshire. North of this line, all the rocks are Palæozoic, and the level gradually rises. The Carboniferous limestone occupies the lower levels about Castleton, Matlock, and Buxton. This is much the most interesting part of the county, and the best known to strangers, the region of lead-mines, caverns, and romantic narrow dales, girdled by high cliffs of limestone: Miller's Dale, Monsal Dale, Ashwood Dale, Chee Tor, Chatsworth, Haddon Hall, are all familiar names alike to botanists and lovers of fine scenery; and Dovedale, Bakewell, and Rowsley are classic ground to anglers. The market-place at Buxton is over 1000 feet above sea-level, so that Buxton is on a par, so far as plants go, with Dundee or Aberdeen. The heights of Abraham, over Matlock, are about the same height above sea-level as the town of Buxton. About Castleton and Buxton the limestone reaches a height of 400 or 450 yards, and with it many plants of the lowlands; for instance, *Epilobium hirsutum*, *Galium cruciatum*, *G. verum*, *Lamium purpureum*, and *L. incisum*, reach a higher level than anywhere else in the country. On the whole, the botany of the Derbyshire limestone tract is most like that of Ribblesdale, Airedale, and Wensleydale. Above the limestone in the Peak country, and around Buxton and Castleton, there is a considerable thickness of shale and millstone grit. The flora of these higher levels is poor and monotonous, but we get the cloudberry (*Rubus Chamæmorus*) on Axe-edge, the bearberry (*Arctostaphylos Uva-ursi*) on the moors round the head of the Derwent, and the whortleberry (*Vaccinium Vitis-idæa*) in several places about Buxton and Glossop. East of all these is an area of coal-measure country, the flora of which seems to be very poor, and to resemble that of the country round Huddersfield, Sheffield, and Halifax.

Mr. Bagnall has already shown, in the *Journal of Botany*, that Mr. Painter's numerical analysis, on p. 4 of the "Derbyshire Plants," classed under their types of distribution, needs material revision. Out of 532 plants universal in Britain, Mr. Bagnall's estimate, founded on Mr. Painter's detailed list of species, is 486 species for Derbyshire. In all probability, most of the other 46 species will be found if they are carefully sought; but, of the 599 species which represent the characteristically southern element in the British flora, there are 238 species in Derbyshire, or less than half. I cannot understand why the figure of the Germanic, or characteristically south-eastern plants, which is 127 for Britain as a whole, 38 for North Yorkshire, 26 for Northumberland and Durham, should be as low as 14 for Derbyshire. Out of 201 boreal British species, there are 39 in Derbyshire against 104 for the Lakes, 93 for Northumberland and Durham, and 76 for North Yorkshire. What Watson called the intermediate type, is a very interesting group; they are concentrated in the north of England, and I suspect that the principal reason of this is, that they are Montane plants with a preference for limestone. The